

Remarks:

**Summary of the April 3, 2009, Office Action**

In the April 3, 2009, Office Action, the Examiner acknowledged Applicants' election without traverse of the claims of Group I (Claims 1-10, 23, 26-39, and 43). Claims 1 and 28 were rejected under 35 U.S.C. Section 112, second paragraph, as being indefinite. Claims 28, 30, 33, 34, and 35 were indicated to have insufficient antecedent basis. Dependent Claims 2-10, 23, 31-35, and 39 were also rejected as they depend upon Claims 1 and 30.

On the merits, Claims 1, 2, 4, 5, 9, and 23 were rejected under 35 U.S.C. Section 102(b) as being anticipated by the Mitchell et al. reference (U.S. Patent No. 6,395,000). Claims 1-5, 10, 36, and 38 were rejected under 35 U.S.C. Section 102(b) as being anticipated by the Angeley reference (U.S. Patent No. 6,282,223). Claims 6-8, 26-28, 30-35, 39, and 43 were rejected under 35 U.S.C. Section 103(a) as being unpatentable over the Angeley reference in view of the Smart reference (U.S. Patent Application Publication No. 2002-0093997). Claim 37 was not rejected on the merits, and thus apparently was only rejected as depending upon Claim 33 which was rejected for indefiniteness.

**Amendments to the Claims**

The claims have been amended to correspond with amended claims in the corresponding European patent application which are expected to be granted following an

interview with the European Examiner regarding the corresponding European patent application. Claim 37, which was not rejected on the merits, has been rewritten in independent form incorporating all of the limitations of the claims upon which it formerly depended (old Claims 26 and 33), as well as correcting the indefiniteness of old Claim 33, making Claim 37 allowable. Newly added dependent Claim 44 replaced old Claim 33 as a dependent claim dependent upon Claim 33.

### **Section 112 Indefiniteness Rejections**

Applicants thank the Examiner for noting the Section 112 indefiniteness deficiencies in claims 1, 28, 30, 33, 34, and 35. Claims 28, 30, 34, and 35 have been cancelled. Claims 1 and 33 have both been amended to eliminate the terms having insufficient antecedent basis. As such, Applicants believe that all of the Section 112 deficiencies noted by the Examiner have been eliminated.

### **Section 102(b) Rejections on the Mitchell et al. Reference**

The Mitchell et al. reference profiles the ends of the rod to "provide correction for the thermal lensing effects" (column 4, line 51). While the Mitchell et al. reference describes the positive effects of a concave curvature as minimizing the beam diameter in the rod (FIG. 3, the degree of curvature of the rod ends determines the thermal lens strength at which this minimum occurs), it also describes the negative focal power of a concave curvature as offsetting the positive effect of the thermal lens (column 4, line 56).

In contrast, independent Claim 1 as amended requires that "each end is profiled concave ... such that the beam has a beam quality maximized..." Independent Claim 38 has a similar limitation. Thus, Claims 1 and 38 are certainly not anticipated by the Mitchell et al. reference, which is completely silent with respect to beam quality (or to the beam quality parameter  $M_2$ ) and is, instead, concerned only with minimizing the beam diameter.

In fact, the claimed invention is the exact opposite of the Mitchell et al. reference, because maximizing beam quality leads to a maximum beam size in the rod. The Mitchell et al. reference therefore teaches away from the claimed invention, and independent Claims 1 and 38 are neither taught nor suggested by the Mitchell et al. reference.

The inventors have recognized that maximizing beam quality: 1. maximizes the gain overlap; (i.e. the amount of the gain medium occupied by the beam); 2. maximizes gain extraction; 3. maximizes the stability with respect to small changes in thermal lensing caused by, for example, laser/diode aging; and 4. avoids the need for at least one curved cavity mirror and, hence, an asymmetric cavity. The Mitchell et al. reference does not even mention beam quality or the beam quality parameter  $M_2$ , let alone realize this four-fold value in maximizing beam quality by appropriate concave profiling in a symmetric cavity.

**Section 102(b) and 103(a) Rejections on the Angeley Reference**

Like the Mitchell et al. reference, the Angeley reference in its totality does not disclose the concept of maximizing beam quality in a symmetric cavity. Instead, the Angeley reference teaches flat-curved rather than flat-flat mirrors because of differential behavior and the need for "mode-fill," i.e. gain extraction (column 4 lines 11-26; column 5 lines 30 to 37). The Angeley reference therefore does not disclose a symmetric cavity, and the claimed invention therefore cannot be anticipated or rendered obvious by the Angeley reference for at least this reason.

Furthermore, the background of Angeley recites that "[f]or many applications ... a laser is not required to have the highest possible beam quality and accordingly is not required to operate in a single fundamental mode." Again, this is the exact opposite of the claimed invention, which seeks to maximize beam quality beam quality (or the beam quality parameter  $M_2$ ) to improve the so-called "dynamic stability." The claimed invention therefore patentably distinguishes itself over the Angeley reference for at least this reason. Moreover, the Angeley reference also teaches away from the claimed invention in at least two key respects: 1. cavity symmetry; and 2. beam quality.

In summary, a goal of the present invention is to alleviate sensitivity to thermal lensing effects while maximizing stable power and gain extraction for a symmetric laser cavity. This is achieved through the use of a configuration in which the beam volume overlaps well within the gain medium and in which beam quality is maximized. More

specifically, the inventors have recognized that maximized power extraction and stability can be achieved by using flat-flat cavity mirrors (symmetric cavity) in conjunction with maximized beam quality.

None of the cited art (including the Smart reference) discloses the claimed combination of features of independent Claims 1 and 38, and it may be noted that by maximizing beam quality and thereby stability and gain extraction [see, for example, page 7, lines 1922] the asymmetry of the Angeley reference is avoided, and flat-flat rather than flat-curved mirrors can be used, thereby maximizing power extraction of the present invention.

### **Conclusion**

Claims 1-4, 6, 8-10, 23, 26, 27, 31-33, 35, 37-39, and 43 remain pending in the present patent application, and Applicants believe that they are in condition for allowance at this time. As such, Applicants respectfully request entry of the present Amendment and reconsideration of the application, with an early and favorable decision being solicited. Should the Examiner believe that the prosecution of the application could be

expedited, the Examiner is requested to call Applicants' undersigned attorney at the number listed below.

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